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The University of Tulsa
600 South College Ave.
Tulsa, Oklahoma 74104
(918) 939-6351

College of Engineering and Physical Sciences
Petroleum Engineering

#13727

August 1, 1979

Mr. Michael A. Lamastra
License Management Branch
Division of Fuel Cycle and Material Safety
U.S.N.R.C.
Washington, D. C. 20555

Dear Mr. Lamastra:

This is to request the following amendments to the University of Tulsa license which is undergoing renewal and combination at this time. The existing license is SNM-957. The new license number has not been assigned yet. The amendments requested are 1) addition of one person to the list of authorized users and 2) the addition of one new source.

Part 6: (add) Mr. Paul Ferguson, P.E.
Consulting Engineer

Part 8: Licensed Material (add the following)
(10)(A) Americium 241;
(B) 1.5 gms in an Am-Be neutron source
(C) Gammatron Model AN-HP sealed source 0.75"d x 2" l
(D) 5 Ci maximum activity
(E) Educational demonstrations and experiments in activation and decay; neutron transport, neutron shielding; thermal neutron cross-sections

The materials attached to this letter support the two requested amendment terms.

Sincerely,

J. Paschal Twyman
J. Paschal Twyman
President
University of Tulsa

FEE EXEMPT

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Part 9. Storage of Sealed Sources (add)

(10)(A) Paraffin filled drum
(B) NSSI Inc., Ft. Worth, TX
(C) N/A custom built

Applicable Sections of Regulatory Guide 10.3

4.2 Activities
The Am-Be source will be used for the same purposes and in the same buildings as the Pu-Be source described in the original license application of July, 1979.

4.3 The inventory of isotopes is the equivalent of 1.5 grams of Am-241 as the oxide.

4.5 All portions are the same as in the license application of July, 1979.

46.2 The 5 Ci source (approximately 10^7 n/S) will produce less than 20 mrem/hr due to neutrons and less than 15 mrem/hr due to gammas at the surface of the container (NSSI manufacturer's data). When in use the containers will be separated from personnel by a minimum of 6 feet. This reduces the level to less than 0.3 mrem/hr. Occupancy of the region adjacent to the 6 ft perimeter is infrequent (less than 5% of a forty hour week). Thus the dose is well under the limits in paragraph 2 of 46.2.

46.3 All portions are the same as in the original license application of July, 1979.

Storage and use of the source will not produce more than .03 mrem/hr in unrestricted areas.

The figures showing the positions within designated rooms and buildings are the same in the original license application of July, 1979.

Part 16. Formal Training (add)

Mr. Paul F. Ferguson
Registered Professional Engineer
5406 E. 24 St.
Tulsa, OK 74114

(918)939-5810

Mr. Ferguson's firm offers research development service for electronic systems.

Mr. Ferguson has completed two courses in the use of isotopes.

1. Twenty-five hours of instruction and demonstrations at the University of Tulsa under Dr. William P. Moran, January 1979. This course devoted approximately one-third of the time to each of the following:
    a) principles and practices
    b) measurement standardization and monitoring
    c) mathematics and calculations.

   The course describes types of radiations, interaction with matter, common isotopes and decay schemes, definitions of radiological health terms and units, calculations of exposure and dose from first principles beginning with the weight of isotope present including all half-life and distance and secondary radiation effects, shielding calculations are made for common radiation, requirements of CFR10 sections on by-products and special nuclear materials are reviewed. This course has been given to other oil industry personnel, University faculty, and the faculty of Oklahoma Oesteopathic Medical School.

   Mr. Ferguson performed satisfactorily on an oral examination and practical measurements. A letter is attached.

2. Sixteen hours of instruction by Mr. Alfred E. Caswell, Health Physicist, on April 21, 22, and 23, 1979. A syllabus and sample test and letter are attached.

The University of Tulsa
600 South College Ave.
Tulsa, Oklahoma 74104
(918) 939-6351

College of Engineering and Physical Sciences
Petroleum Engineering

July 31, 1979

Mr. Paul M. Ferguson
5406 E. 24 St.
Tulsa, OK 74114

Dear Mr. Ferguson:

This is to certify that you have completed the twenty-five hours of instruction and experiments on radiation safety and protection, measurement standardization and monitoring, and the mathematics and calculations for the use and measurement of radioactivity.

Your responses to oral examination and practical measurements was excellent.

Sincerely,

W. P. Moran

W. P. Moran
Associate Professor
Physics

bp

ALFRED E. CASWELL
Health Physicist
10302 N. ROCKWELL
OKLAHOMA CITY, OKLA. 73132
PHONE 405-631-2339

April 23, 1979

To Whom It May Concern:

Mr. Paul M Ferguson, Consultant, has successfully completed my course in Radiological Safety. The course was held on April 21, 22, and 23, 1979, in the offices of ARCO Oil and Gas Company in Prudhoe Bay, Alaska.

The enclosed Course Outline indicates the scope of the course.

My qualifications include some twenty years active in Health Physics. I have a B.S. Degree in Chemistry and Math and I have completed the basic and advanced courses in Health Physics given by the U.S. Public Health Service of Cinn., Ohio. I served as the Radiological Safety Officer for Well Surveys, Inc., Tulsa, Oklahoma; the Lane Wells Co. (Now Dresser Atlas), Houston, Texas; General Nuclear, Inc., Houston, Texas and SIE, Inc., Fort Worth, Texas. I have taught over forty short courses in Radiological Safety as it applies to oil and mineral logging.

I consider Mr. Paul M. Ferguson qualified to work with the radioactive sources that he will be concerned with during his project work.

Very truly yours,

Alfred E. Caswell

Alfred E. Caswell

AEC:yh

Enclosures

ALFRED E. CASWELL
Health Physicist
10302 N. ROCKWELL
OKLAHOMA CITY, OKLA. 73132

PHONE 405-631-2339

Radiological Training Course

Course Outline

First Day

8:30 a.m.	Registration & Assignment of Manuals
9:00 a.m.	Explanation of Course
9:30 a.m.	Nature of Matter - Radiation Training Manual
10:00 a.m.	Coffee
10:15 a.m.	The Atom - Radiation Training Manual
11:00 a.m.	Radioactivity - Radiation Training Manual
12:00 noon	Lunch
1:00 p.m.	Radiation & Matter - Radiation Training Manual
1:45 p.m.	Penetration & Travel of Alpha,Beta & Gamma Radiation - Demonstration
2:00 p.m.	Some Characteristics of Radiation - Radiation Training Manual
3:00 p.m.	Coffee
3:15 p.m.	Some Characteristics of Radiation - Radiation Training Manual (con't)
5:00 p.m.	Completion of First Day.
Evening	Study

Second Day

8:30 a.m.	Review of First Day
9:30 a.m.	Radioactivity Health Considerations - Radiation Training Manual
10:00 a.m.	Coffee
10:15 a.m.	Radioactivity Health Considerations - Radiation Training Manual (con't)
11:15 a.m.	How is Radioactivity Detected - Radiation Training Manual
12:00 noon	Lunch
1:00 p.m.	Survey Meter Calibration - Demonstration
1:30 p.m.	Radiation Safety Procedures - Radiation Safety Procedures Manual
3:00 p.m.	Coffee
3:15 p.m.	Radiation Control Regulations - Radiation Training Manual
4:00 p.m.	Course Test
5:00 p.m.	Course Critique
5:30 p.m.	Completion of Course

Name Paul M Ferguson

Date Apr 23, 1979

Consultant ARCO
(Brill Engineering of Tulsa, OK)

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FINAL TEST

1. The nucleus of an atom consists primarily of:

   a. neutrons and electrons bound together by binding energy
   b. electrons and protons
   c. neutrons and protons which are held together by binding energy
   d. positrons and negatrons

2. Electrons are:

   a. negatively charged particles with a mass of one
   b. neutral and have a mass of one
   c. positively charged particles with a mass of one
   d. negatively charged particles with essentially no mass

3. Protons are:

   a. negatively charged particles with a mass of one
   b. neutral and have a mass of one
   c. positively charged particles with a mass of one
   d. negatively charged particles with essentially no mass

4. The isotope ${}_{15}P^{31}$ has:

   31
   15
   16

   a. 16 neutrons in the nucleus
   b. 15 neutrons in the nucleus
   c. 31 neutrons in the nucleus
   d. 46 neutrons in the nucleus

5. Alpha particles possess:

   a. little ionizing power but relatively great penetrating power
   b. a mass of one and a negative charge of two
   c. great ionizing power but relatively little penetrating power
   d. a mass of two and a negative charge of two

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6. Gamma radiation consists of:

   a. electromagnetic radiations with great penetrating power
   b. Positively charged particles with relatively little penetrating power
   c. negatively charged radiations with great penetrating power
   d. electromagnetic radiations originating in the orbits of atom

7. Neutrons are easily shielded by:

   a. lead due to its high density
   b. wax due to its high hydrogen content
   c. wax due to its high density
   d. aluminum

8. The basis of most radiation detection is ionization. Ionization is simply:

   a. the knocking of an electron from the orbit of an atom thereby creating an ion
   b. the creation of light photon within the detector
   c. the removal of a proton from the nucleus of an atom thereby creating an ion
   d. the raising of the energy level of an atom

9. The basic difference in the operating characteristics between an ionization chamber, proportional counter and Geiger-Muller detector is:

   a. the geiger-Muller detectors and proportional counters detect gamma radiation only
   b. in the input voltage
   c. the scintillation effect
   d. in the output voltage

10. Scintillation detectors operate on the basis of:

a. ionization taking place within certain organic and inorganic crystals
b. the separation of alpha, beta and gamma radiation within organic phosphors
(c.) the production of a photon of light within certain organic and inorganic phosphors
d. ionization chambers

11. The Curie is the quantity of a radioactive nuclide disintegrating at the rate of 3.7×10^{10} atoms per second.

12. The dose unit Roentgen applies to gamma radiation only.

13. The Relative Biological Effectiveness factor for fast neutrons is 10.

14. Half Life is the time required for the activity of a given radioactive isotope to decrease to half of its initial value due to radioactive decay.

15. We normally refer to the energy of ionizing radiation in units of MEV (Electron Volts $\times 10^6$).

16. A total body dose of 600 REM + will cause nausea and vomiting almost immediately with death in one to two weeks.

17. The whole body tolerance for a calender quarter (13 weeks) established by the AEC and State of Texas is 1.25 rems.

18. The quarterly tolerance for the hands is 18.75 rems.

19. The three safety factors to be considered at all times when working with radioactive material are Distance, Time and Shielding.

20. Sealed logging sources are to be leak tested every six months or 180 days or less.

(a.) True
b. False

21. Determine the dose rate at one foot from a 12 millicurie Cesium-137 source. Effective energy of Cesium-137 is 0.55 Mev.

$R = 6CE = 6 \times 12 \times .55 = 39.6$ mrem/hr @ 1'

22. Twenty days ago we received a twenty millicurie shipment of Iodine-131. How much do we have today? Half life of Iodine-131 is eight (8) days.

$\frac{20}{8} = 2\frac{1}{2}$ half life = 18%

20 mc x .18 = 3.6 mc

23. The dose rate at three feet from a neutron source is 42 mrem/hr. What would be the dose rate at nine feet?

$$I_1 D_1^2 = I_2 D_2^2$$

$$I_2 = \frac{I_1 D_1^2}{D_2^2} = \frac{42 \times 3^2}{9^2} = 4.66 \text{ mrem/hr @ } 9'$$

24. What is the neutron dose rate (mrem/hr) at 100 centimeters (approximately 40 inches) from a neutron logging source which emits 6 x 10^6 neutrons/second?

$$R = \frac{6 \times 10^6}{12.57 \times 100^2} \times .14 = \frac{600 \times .14}{12.57} = 6.68 \text{ mrem/hr @ } 100 \text{ cm}$$

Part 17. Experience with Radiation and Devices

1) See resume for general background of Paul M. Ferguson

2) Atlantic Richfield, Prudhoe Bay, Alaska.
   Several months of theoretical planning and field operating experience using Texas Nuclear SG series density gauges. These tests were made in 1978 and 1979 using 50, 1000, and 3000 mc sources of 137 CS.

3) University of Tulsa, Tulsa, Oklahoma.
   On a consulting basis worked to develop schemes to analyze fluid flow in pipe lines. The equipment was Texas Nuclear SG series density gauges. The sources were 50 and 500 mc of 137 CS. The time period 1977, 1978 and 1979.

4) Atlantic Richfield Research Lab in Plano, Texas. Several months in 1979 spent developing methods and equipment to study fluid flow in pipe lines. Sources were 1 mc of Co-60, 100 mc of Cs-137, 5000 mc of Am Be. Detectors used: Eberline PRM 5, Texas Nuclear 9390, and Atlantic Richfield custom designs.

#137257

RESUME:

Paul M. Ferguson, 5406 East 24th Street, Tulsa, OK., 74114, Ph. (918)939-5810

EXPERIENCE:

August 1971 to date: Consulting engineer offering research, development, and service on electronic systems. Projects vary from drilling rig and archaeological instruments to a light show proto-type.

April 1965 to August 1971: Seismograph Service Corporation, Senior Research Engineer. Design engineer and/or project leader on: Seismic recording systems, computer controlled data acquisition system, magnetic correlator, and a "secure" data transmission system using artificial Telluric currents. Also in charge of hardware development and training field personnel for Raytheon 703/706 seismic data processing systems. One year study of hydraulic vibrator performance.

April 1957 to April 1965: Jersey Production Research Company, Research Physicist. Design engineer and/or project leader on: Seismic playback systems, transistorized seismic recording system, "sequential" blasters, a self contained remote controlled drill string magnetic tape recorder that records bit forces and motions during oil well drilling, several investigations for radical improvements in geophysics, drilling rig instrumentation using strain gauges and various transducers and numerous small items such as amplifiers, power supplies, and control circuits. Several patents are pending, one issued.

December 1951 to April 1957: Seismograph Service, Research Engineer, Design Engineer and/or project leader on: 2 seismic recording and playback systems, radio communication system, and many small assemblies, some field instrument supervision.

December 1950 to December 1951: Dayton Engineering, Engineer. Design, Manufacture, testing, installation and service of geophysical equipment.

August 1949 to December 1950: Amerada Petroleum Corporation. Instrument operator on field seismic crew.

March 1943 to February 1946: U. S Army, Radio operator in communication section.

August 1942 to March 1943: Transmitter operator radio WMVA, Martinsville, VA

EDUCATION:

1941 - High school, Toronto, Kansas, graduate.

1942 - Valparaiso Technical Institute, Valparaiso, Indiana, Radio Operator Course, graduate.

1949 - University of Kansas, B. S. Degree in Engineering Physics.

Also - Army schools, "company" courses, correspondence, night, refresher, and short courses at various colleges. All computer schools offered by Ratheon.

PERSONAL:

Born April 8, 1923, height 5'10", weight 170 lbs, married, 2 dependents, Health good, U. S. citizen. Secret clearance at Seismograph. Registered Professional engineer, member of 3 professional societies.

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